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(54) FLUID-AND-ELASTOMER DEVICE

EINHEIT MIT FLÜSSIGKEIT UND ELASTOMER

DISPOSITIF A FLUIDE ET ELASTOMERE

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(56) References cited:
EP-A- 0 334 716 **GB-A- 758 908**
US-A- 4 613 118 **US-A- 4 733 854**
US-A- 4 768 760

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Description

Field of the Invention

This invention relates to the area of fluid-and-elastomer devices. Specifically, the invention relates to the area of fluid-and-elastomer devices for providing damping for lead-lag motions of a helicopter rotor blade.

Background of the Invention

Flexible dampers for attachment between a rotor hub assembly and a rotor blade or cuff which exhibit a high degree of damping are desirable for damping lead-lag motions of rotor blades on helicopters. Typically, elastomers are used to provide this damping, such as taught in US patent 5,092,738 to Byrnes et al., US patent 4,778,343 to Hahn et al., and US patent 4,893,988 to Sato. The high degree of damping exhibited by these dampers is typically produced by bonding the dampers in a highly-damped elastomer such as silicone. However, these elastomeric dampers are inherently nonlinear as a function of amplitude and can produce a loss factor of only about 0.7. This is insufficient, under certain conditions, to control excessive motions of the helicopter rotor blade.

Additional damping can be added, over and above what is available in an elastomeric damper, by incorporating a fluid within the damper to provide damping at certain predetermined, or tuned, frequencies. The commonly assigned US patent 4,811,919 to Jones describes the addition of fluid to an elastomeric mounting which is suitable for mounting an aircraft engine to a strut, and also describes the means for compensating for the fluid expansion due to temperature changes. US patent 4,236,607 to Hawles et al. describes a vibration suppression system wherein the fluid passes through the inner member of the mounting to provide amplified counter inertial forces.

US patent 4,566,677 to Le Pierres describes a damped fluid-and-elastomeric, lead-lag damper for helicopter rotor blades, whereby the fluid is used to add additional damping over and above what is available from the elastomer alone. However, this damper is axially-acting and cannot carrying vertical loads due to flapping, which must be accommodated in bearingless rotor systems. Furthermore, US patent 5,004,215 to Aubry et al. (EP-A-0 334 716) describes another axially acting strut-type damper with linear damping by incorporating a viscous fluid. Again, this device cannot carry vertical loads due to flapping motions of the rotor blade, a normally required feature of dampers which are to be used in bearingless rotor systems.

In rotor-damping systems, and in fluid devices in general, the requirements for high damping, which necessitates the use of damped elastomers and viscous fluids, tend to make the dampers undesirably stiff when exposed to low temperatures. The Aubry et al. '215 de-

vice describes a resilient return strut for use with helicopter rotors which uses reed-type valves for limiting the pressure which can build up within the fluid chambers. However, these types of pressure-limiting valves do not allow for free flow of fluid during normal operating conditions. US patent 4,613,118 to Morita describes a fluid mounting suitable for connecting to an engine which incorporates a valve mechanism 450 to limit the pressure within the fluid chamber. Upon encountering a situation which requires pressure relief, a threshold pressure is exceeded, and more flow area is opened in fluid-parallel relation with the fluid orifice. This mechanism is complicated, non-linear, in that it has different properties in each direction, and requires a separate orifice and valve in parallel in order to get unimpeded or unblocked flow for normal operating conditions. Alternate embodiments in Morita allow for the valve and fluid-flow, path to be in a fluid-series relationship. However, this arrangement does not allow for unblocked flow during normal operating conditions.

Summary of the Invention

In light of the advantages and shortcomings of the similar dampers, it is therefore a primary object to provide a fluid-and-elastomer, lead-lag damper for helicopter rotors which can carry vertical flap loads.

Another objective is to provide a fluid-and-elastomer, lead-lag damper for use on a helicopter rotor system which provides linear rotor blade damping as a function of amplitude and also is capable of carrying vertical flap loads.

The present invention consists in a fluid-and-elastomer device having the features of claims 1.

It is an advantage of the present invention that the passageway assembly can provide linear damping and pressure relief, all within one integrated package.

It is among the advantages of the present invention that the fluid-and-elastomer damper can be utilized to provide a damping loss factor of about 1.3 and can be used in bearingless rotor systems.

The above mentioned and further objects, features and advantages of the present invention will become apparent from the accompanying descriptions of the preferred embodiment and attached drawings.

Brief Description of the Drawings

The accompanying drawings which form a part of the specification, illustrate an embodiment of the present invention the drawings and description together, serve to fully explain the invention. In the drawings,

Fig. 1 is a side view in partial section showing the installed environment of an embodiment of the fluid-and-elastomer device;

Fig. 2 is a sectioned front view illustrating an embodiment of the device;

Fig. 3 is a sectioned side view of the device;
 Fig. 4 is a top view of the device;
 Fig. 5 is another frontal sectional view of the device;
 Fig. 6 is a sectioned top view of the device;
 Fig. 7 is a breakout view of the device showing the floating member in a pressure relieving position;
 Fig. 8 is a performance plot of K^* , K' , and K'' as a function of amplitude of the device; and
 Fig. 9 is a performance plot of loss factor as a function of amplitude of the device.

Detailed Description of the Invention

In Fig. 1, an embodiment of a fluid device 20 is shown installed in the environment of the bearingless rotor system 10. The bearingless rotor system generally includes a rotor hub 11 which is preferably of composite construction and which attaches to a mast (not shown) of a helicopter, and a centering bearing 12 or other intermediate member which is generally an elastomeric bearing and which is attached to rotor hub 11 via a shaft 13, or other means. It also includes a rotor cuff 14 which surrounds the portion of the rotor hub 11 shown and which is preferably of aluminum, but may be of composite construction. A pitch horn 18 is generally attached to the rotor cuff 14 such that pitch control can be imparted to the cuff 14 and rotor blades (not shown). The system shown also includes the fluid device 20 of the present invention, as contrasted with prior systems generically known as bearingless rotor systems 10, which utilized purely elastomeric dampers. The fluid device 20 describe herein was initially conceived for use in the bearingless rotor environment; however, more conventional installations can be envisioned, as well.

As shown in Fig. 2, the fluid device 20 includes a piston 22 which pumps the fluid within the fluid device 20 and which attaches to the previously mentioned centering bearing 12, or other intermediate member which acts as the means for connecting or interconnecting to the rotor hub 11. The fluid device 20 includes an elastomer section 24, of preferably laminated shim-and-elastomer construction, which defines a portion of a first variable-volume chamber 26 and which also defines a portion of a like, and generally opposed, second variable-volume chamber 28. The elastomer section 24 also provides the stiffness for reacting vertical loads which are due to relative flapping motions which occur between the rotor cuff 14 and rotor hub 11.

A housing 30 also defines a portion of the first and second variable-volume chambers 26 and 28, and encloses virtually the entire inner workings within the fluid device 20. The housing 30 is preferably made of aluminum and is anodized for corrosion protection and includes a first half 32 and a second half 34 which are bolted together, recessed in, and fastened to, the rotor cuff 14. The piston 22 may include two primary passageways formed therethrough for connecting, and allowing damping fluid 38 to flow between, the first variable-volume

chamber 26 and second variable-volume chamber 28. The fluid 38 is contained within, and substantially fills, the first variable-volume chamber 26, second variable-volume chamber 28, and interconnecting passageways.

The fluid device 20 also includes pressurizer 40 of the compressed-air type for statically pressurizing the fluid 38 such that cavitation of the fluid 38 under large amplitudes does not occur. Other means for pressurizing and compensating for fluid expansion could be used as well. The pressurizer 40 also compensates for expansion and contraction of the fluid 38 due to temperature changes. The pressurizer 40 includes a third chamber 42 which is annular shaped and is interconnected to one of said first and second chambers 26 and 28 by way of a small passageway 43, a separator 44 such as a flexible diaphragm which includes seal 45, a fourth chamber 46 which is annular in shape and which is filled, under pressure, with air or the like, a plate 48 for attaching to second half 34 by way of bolts 49, and a valve 50 for providing the access for pressurization.

The piston 22, elastomer section 24 and outer member 53 together make up the insert assembly 52 which is inserted between halves 32 and 34 of housing 30. As halves 32 and 34 are urged together by bolts not shown, the O-rings 54 are compressed to form a permanent seal to prevent escape of the fluid 38. Displacement of the piston 22 relative to the housing 30 will cause fluid 38 to be displaced between the first and second variable-volume chambers 26 and 28. The piston 22 includes an inner member 55, a spacer 56 which is located relative to the inner member 55 by way of pins 58, and a fastener 60. Threads 59 formed within fastener 60 attach to a stud (not shown) which is, in turn, attached to centering bearing 12 (Fig. 1). Tightening fastener 60 urges centering bearing 12 (Fig. 1) in contact with spacer 56. The bores 62 accept pins which are press fit into the centering bearing 12 (Fig. 1) in the same manner as the pins 58 are installed in the spacer 59. A pin 64 is cross drilled and pressed into the inner member 55 such that safety wire (not shown) can be placed through the cross-drilled hole in the fastener 60 and also through cross-drilled hole in pin 64, and thus, restrain fastener 60 from turning and unscrewing.

Another view of the fluid device 20 is illustrated in Fig. 3. The shims 66 are flat and extend in a plane perpendicular to the line of vertical load application A. Two primary passageways 68 extend between first variable- and second variable-volume chambers 26 and 28 (Fig. 2). The elastomer section 24 wraps completely around the inner member 55 and is preferably a natural rubber elastomer with a loss factor (tan delta) of less than 0.4, and more preferably a loss factor (tan delta) of about 0.1. The elastomer section 24 is preferably integrally bonded to outer member 53 and to inner member 55. Further, close tolerances between the outer member 53 and the inner surfaces 70 of the upper and lower halves 32 and 34 will allow fluid 38 (Fig. 2) to flow only through

the primary passageways **68**.

Another view is illustrated in **Fig. 4**. Fluid device **20** is shown with bores **74** through flanges **72** in first and second halves **32** (**Fig. 3**) and **34** of housing **30**. Fastener **60** includes an internal hex as shown. Further, all bolts **49** and bolts **76** are wired together by safety wire **75**.

Another view of the fluid device **20** is illustrated in **Fig. 5** wherein one of the passageway assemblies **80A** is shown installed in the inner member **55**. A like passageway **80B** is shown in **Fig. 6**. The assemblies **80A** and likewise **80B** (**Fig. 6**), include a floating member **82** which has a seat **84** which seals against a similar seat formed in inner member **55**. The assemblies **80A** and **80B** (**Fig. 6**) also includes a spring **86** which biases the seat **84** against inner member **55** and an adjuster **88** which adjusts the compression of spring **86**. The floating member **82** includes a central portion **90** over which the spring **86** is located and slides. The central portion **90** also slides freely within bore **92** formed in adjuster **88**. The adjuster **88** includes screwdriver slots **96** and/or a wrench profile for providing for adjustment.

Integral with the assembly **80A** and also **80B** (**Fig. 6**) are the primary passageways **68** having a diameter **D** and a length **L** which are chosen to provide linearity, such that for selected ranges, the stiffnesses K^* , K' and K'' remain constant. K^* is the complex stiffness, K' is the real, or in-phase stiffness, while K'' is the imaginary, or out-of-phase, stiffness. By way of example and not by limitation, the present invention fluid device **20** provides complex stiffness K^* which is linear for amplitudes of 0.025 to 0.89 cms (0.01 to 0.35 inch) with values of stiffness K^* between approximately 1.29×10^5 - 1×10^5 kg-m⁻¹ (7200 lb/in and 5600 lb/in) at approximately 5 Hz. The linear range is defined as the range wherein not more than 15% deviation from nominal K^* is present. Linear damping is achieved by the appropriate choice of diameter **D**, and length **L** and viscosity μ . By way of example, the diameter **D** of the present invention should be in the range of 0.13 - 1.27 cms (0.05 and 0.5 inch), and the length **L** should be in the range of 0.64 - 6.35 cms (0.25 and 2.5 inch). Furthermore, the kinematic viscosity should be in the range of between 1×10^{-3} to 1×10^{-2} m².s⁻¹ (1,000 and 10,000 centistokes (cs)) and more preferably 2×10^{-3} m².s⁻¹ (2000 cs). One very distinct advantage is that the present invention allows for linear damping level regardless of the direction of fluid flow. The transition zone **94** which occurs at the entrance and exit to the passageway **80** each have a diameter **D'** and a length **L'** such that the conditions imposed for each direction result in uniform losses. This is particularly important in systems which require linearity as a function of amplitude in each direction.

Another view is illustrated in **Fig. 6** which shows the fluid device **20** and two passageway assemblies **80A** and **80B**. The passageway assemblies **80A** and **80B** allow fluid **38** to flow between the chambers **26** and **28**. The two primary passageways **68** within the assemblies

80A and **80B** are in fluid-parallel relationship and are unblocked for normal conditions. For normal operating conditions, the damping level is also linear as a function of amplitude, due to the appropriate choice of the diameter **D**, length **L** and kinematic viscosity μ of the damping fluid. These parameters can be adjusted to allow for linearity of K^* , K' , and K'' . In addition, the flow of fluid **38** through each primary passageway **68** is approximately equal. However, when a threshold pressure differential is reached between the fluid chambers **26** and **28**, the floating member **82** within the assembly **80A** or **80B** will open, depending on direction, and allow more fluid-flow area to be accessible through auxiliary flow path **98** (**Fig. 3**), which in this case are shown as channels. This will limit the maximum pressure that can occur when high-amplitude conditions are imposed on the fluid device **20**, and also when very cold temperature conditions are encountered, which causes an increase in fluid viscosity. In addition, the passageway **68** and the pressure-relief valve are integrated into one package within the passageway assemblies **80A** and **80B**.

The floating members **82** of the passageway assemblies **80A** and **80B** act in different directions. The floating member **82** of each assembly **80A** and **80B** are oriented to act in one direction only. In other words, the auxiliary flow path can only flow in one direction for providing pressure relief. In this manner passageway assembly **80A** only opens when the threshold fluid pressure differential is exceeded and the highest pressure occurs in chamber **26**. Likewise, passageway assembly **80B** only opens when the threshold fluid-pressure differential is exceeded and the highest pressure occurs in chamber **28**. In this way, even when under going a pressure-relief situation, equal amounts of damping can be present in each direction. In summary, these pressure-relief valves within the assemblies **80A** and **80B** act in such a manner that when normal conditions occur, the seats **84** of floating members **82** are in contact with the inner member **55** and the auxiliary flow path **98** has no fluid flowing in it. Upon reaching the threshold pressure, the floating member **82** is opened, and fluid **38** flow is channeled through the auxiliary flow path **98**, such as the plurality of channels shown.

A breakout view of the passageway assembly **80A** is illustrated in **Fig. 7**. The assembly **80A** includes a floating member **82** which includes a valve face **84** which seals against a seat formed in inner member **55**. The assembly **80A** also includes a spring **86** which biases or spring loads the valve face **84** against the seat in the inner member **55**. The coil spring shown has a spring rate of about 75 lb/in. The assemblies also include an adjuster **88** which adjusts the compression of spring **86**. The adjuster **88** includes screwdriver slots **96** and/or a wrench profile and is threaded to providing the means for adjustment of the amount of pressure exerted on the seat **84** point of break, or the point at which pressure relief starts. This pressure relief/passageway device is integrated into one compact package which can

be used to limit the pressure in one direction. In order to limit the pressure in two directions, two opposed assemblies **80A** and **80B** are used.

Fig. 8 illustrates a performance curve for the fluid device **20**. This particular damper was tuned to provide linearity in K'' over a broad range of amplitudes and at about 5 Hz. The parameters can be adjusted such that linearity occurs at other frequencies over a broad frequency range.

Fig. 9 illustrates a performance curve for the fluid device **20**. The loss factor ($\tan \delta$) is shown as being relatively insensitive to amplitude or linear as a function of amplitude. The loss factor for this embodiment can range from about 1.3 to 1.1 depending on amplitude. However, note that the K' component is relative low and in fact, the real component K' is less than the damping component K'' .

Claims

1. A fluid-and-elastomer device (20) including a first variable-volume chamber (26); a second variable-volume chamber (28); a housing (30) defining a portion of said first and said second variable-volume chambers; a removable passageway assembly (80A) interconnecting said first and said second variable-volume chambers, said passageway assembly further including a primary passageway (68) integrated into said removable passageway assembly having an entrance and an exit which are each unblocked for normal operating conditions and equal length L and diameter D transition zones adjacent said entrance and said exit resulting in equal losses in each direction, an auxiliary flow path (98) integrated into said removable passageway assembly such that flow through said auxiliary path is allowed in one direction from one of said first and said second variable-volume chambers to the other of said first and second variable-volume chambers when the pressure differential is above a threshold pressure occurring between said first and said second variable-volume chambers; a fluid contained within said first and second variable-volume fluid chambers and said primary passageway; a piston (22) that when displaced relative to said housing said fluid is displaced through said primary passageway between said first and second variable-volume chambers; said device being characterized by
 - a) a single elastomer section (24) defining a portion of each of said first and said second variable-volume chambers, said elastomer section providing a high-volume stiffness to each of said first and second variable-volume chambers, and, b) said primary and said auxiliary flow paths utilizing a common entrance.
2. A fluid-and-elastomer device in accordance with claim 1 being further characterized by said fluid contained within said damper having a kinematic viscosity in the range between 1,000-10,000 cs.
3. A fluid-and-elastomer device in accordance with claim 2 being further characterized by said fluid contained within said damper having a kinematic viscosity of about 2000 cs.
4. A fluid-and-elastomer device in accordance with claim 1 being further characterized by said primary passageway having a length L which is between the range of 0,625 cm and 6,25 cm (0.25 and 2.5 inch).
5. A fluid-and-elastomer device in accordance with claim 1 being further characterized by said primary passageway having a diameter D between the range of 0,125 cm and 1,25 cm (0.05 and 0.5 inch).
6. A fluid-and-elastomer device in accordance with claim 1 being further characterized by said elastomer section including an elastomer having a loss factor of less than 0.4.
7. A fluid-and-elastomer device in accordance with claim 1 being further characterized by means (50) for pressurizing said fluid.
8. A fluid-and-elastomer device in accordance with claim 1 being further characterized by said fluid having a kinematic viscosity μ and said diameter D, length L and kinematic viscosity μ are chosen to give stiffness K^* , K' , and K'' which is linear as a function of amplitude.
9. A fluid-and-elastomer device in accordance with claim 1 being further characterized by a floating member within said passageway assembly which is spring loaded by a coil spring having a stiffness of 1339 Kg/m (75 lb/in).
10. A fluid-and-elastomer device in accordance with claim 1 being further characterized by said auxiliary passageway including a plurality of channels.
11. A fluid-and-elastomer device in accordance with claim 1 being further characterized by said fluid-and-elastomer device including two passageway assemblies formed within, each of which acts in a different direction such that one limits the pressure differential between said first and said second variable-volume chambers in one direction and the other limits the pressure differential between said first and said second variable-volume chambers in the other direction.
12. A fluid-and-elastomer device in accordance with

claim 1 being further characterized by said passageway assembly including a floating member having a seat for sealing said fluid from flowing through said auxiliary flow path.

13. A fluid-and-elastomer device in accordance with claim 12 being further characterized by means to adjust the amount of pressure exerted on said seat.

Patentansprüche

1. Fluid- und Elastomereinrichtung (20) mit einer ersten Kammer (26) mit variablem Volumen, einer zweiten Kammer (28) mit variablem Volumen, einem Gehäuse (30), welches einen Teil der ersten und der zweiten Kammer mit variablem Volumen definiert, einer lösbaren Durchlaßanordnung (80A), die die erste und die zweite Kammer mit variablem Volumen verbindet, wobei die Durchlaßanordnung darüber hinaus einen Primärdurchlaß (68) umfaßt, der in die lösbare Durchlaßanordnung integriert ist, mit einem Einlaß und einem Auslaß, die unter normalen Betriebsbedingungen unblockiert sind und mit Übergangszonen gleicher Länge L und Durchmesser D angrenzend an den Einlaß und den Auslaß, die zu gleichen Verlusten in jeder Richtung führen, einem Hilfsströmungsdurchlaß (98), der in die lösbare Durchlaßanordnung integriert ist derart, daß eine Strömung durch den Hilfsdurchlaß von der ersten und der zweiten Kammer mit variablem Volumen zu der jeweils anderen Kammer mit variablem Volumen in einer Richtung gestattet ist, wenn das Druckdifferential oberhalb eines Druckschwellenwertes liegt, welcher eintritt zwischen der ersten und der zweiten Kammer mit variablem Volumen, und ein Fluid enthalten ist innerhalb der ersten und der zweiten Kammer mit variablem Volumen sowie dem Primärdurchlaß, wobei durch eine Verschiebung eines Kolbens (22) relativ zum Gehäuse Fluid durch den Primärdurchlaß zwischen der ersten und der zweiten Kammer mit variablem Volumen führbar ist,

gekennzeichnet durch

- a) einen einzelnen Elastomerabschnitt (24), der einen Teil der ersten und der zweiten Kammer mit variablem Volumen definiert, wobei der Elastomerabschnitt eine Hochvolumensteifigkeit für die erste und die zweite Kammer mit variablem Volumen bereitstellt und b) einen gemeinsamen Einlaß für die Primär- und Hilfsströmungsdurchlässe.
2. Fluid- und Elastomereinrichtung nach Anspruch 1, dadurch gekennzeichnet, daß das Fluid innerhalb des Dämpfers eine kinematische Viskosität besitzt im Bereich zwischen 1.000 und 10.000 cs.

3. Fluid- und Elastomereinrichtung nach Anspruch 2, dadurch gekennzeichnet, daß das Fluid innerhalb des Dämpfers eine kinematische Viskosität von etwa 2.000 cs besitzt.

4. Fluid- und Elastomereinrichtung nach Anspruch 1, dadurch gekennzeichnet, daß der Primärdurchlaß eine Länge L besitzt, die im Bereich von 0,625 cm und 6,25 cm (0,25 und 2,5 Zoll) liegt.

5. Fluid- und Elastomereinrichtung nach Anspruch 1, dadurch gekennzeichnet, daß der Primärdurchlaß einen Durchmesser D im Bereich zwischen 0,125 cm und 1,25 cm (0,05 und 0,5 Zoll) besitzt.

6. Fluid- und Elastomereinrichtung nach Anspruch 1, dadurch gekennzeichnet, daß der Elastomerabschnitt ein Elastomer mit einem Verlustfaktor von weniger als 0,4 aufweist.

7. Fluid- und Elastomereinrichtung nach Anspruch 1, gekennzeichnet durch eine Einrichtung (50) zur Unterdrucksetzung des Fluids.

8. Fluid- und Elastomereinrichtung nach Anspruch 1, dadurch gekennzeichnet, daß das Fluid eine kinematische Viskosität μ besitzt und der Durchmesser D, die Länge L und die kinematische Viskosität μ derart ausgewählt sind, daß sich eine Steifigkeit K^* , K' und K'' ergibt, die linear ist als Funktion der Amplitude.

9. Fluid- und Elastomereinrichtung nach Anspruch 1, gekennzeichnet durch ein Schwimmelement innerhalb der Durchlaßanordnung, welches unter der Belastung einer Schraubenfeder steht mit einer Federkennung von 1.339 kg/m (75 lb/in).

10. Fluid- und Elastomereinrichtung nach Anspruch 1, dadurch gekennzeichnet, daß der Hilfsdurchlaß eine Mehrzahl von Kanälen umfaßt.

11. Fluid- und Elastomereinrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Fluid- und Elastomereinrichtung zwei Durchlaßanordnungen umfaßt, die hierin ausgebildet sind, von denen jede in eine andere Richtung wirkt derart, daß die eine das Druckdifferential zwischen der ersten und der zweiten Kammer mit variablem Volumen in einer Richtung begrenzt und die andere das Druckdifferential zwischen der ersten und der zweiten Kammer mit variablem Volumen in der anderen Richtung begrenzt.

12. Fluid- und Elastomereinrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Durchlaßanordnung ein Schwimmelement umfaßt mit einem Sitz zur Abdichtung der Strömung des Fluids durch den

Hilfsströmungsdurchlaß.

13. Fluid- und Elastomereinrichtung nach Anspruch 12, gekennzeichnet durch eine Einrichtung zur Einstellung des Druckausmaßes auf den Sitz.

Revendications

1. Dispositif à fluide et élastomère (20) comprenant une première chambre à volume variable (26) ; une seconde chambre à volume variable (28); un logement (30) qui définit une partie desdites première et seconde chambres à volume variable; un ensemble formant passage amovible (80A) qui relie entre elles lesdites première et seconde chambres à volume variable, ledit ensemble formant passage comprenant, en outre, un passage primaire (68) intégré dans ledit ensemble formant passage amovible et comportant une entrée et une sortie qui sont débloquées pour des conditions de fonctionnement normal et des zones de transition de longueur L égale et de diamètre D égal adjacentes à ladite entrée et à ladite sortie pour engendrer des pertes égales dans les deux directions, un chemin d'écoulement auxiliaire (98) intégré dans ledit ensemble formant passage amovible de façon qu'un écoulement à travers ledit chemin auxiliaire soit autorisé dans une seule direction de l'une desdites première et seconde chambres à volume variable vers l'autre lorsque la pression différentielle est supérieure à une pression de seuil apparaissant entre lesdites première et seconde chambres à volume variable; un fluide contenu dans lesdites première et seconde chambres à volume variable et dans ledit passage primaire; un piston (22) tel que, lorsqu'il est déplacé par rapport audit logement, le fluide est déplacé à travers ledit passage primaire entre lesdites première et seconde chambres à volume variable; ledit dispositif étant caractérisé par

a) un élément en élastomère unique (24) définissant une partie de chacune desdites première et seconde chambres à volume variable, élément en élastomère qui confère une rigidité en volume importante à chacune desdites première et seconde chambres à volume variable, et
b) le fait que lesdits chemins d'écoulement primaire et auxiliaire utilisent une entrée commune.

2. Dispositif à fluide et élastomère selon la revendication 1, également caractérisé par le fait que ledit fluide contenu dans ledit amortisseur a une viscosité cinématique dans la plage de 1 000-10 000 cs.
3. Dispositif à fluide et élastomère selon la revendication 2, également caractérisé par le fait que ledit fluide

de contenu dans ledit amortisseur a une viscosité cinématique d'environ 2 000 cs.

4. Dispositif à fluide et élastomère selon la revendication 1, également caractérisé par le fait que ledit passage primaire a une longueur L qui se situe dans la plage de 0,625 cm à 6,25 cm (0,25 à 2,5 pouces).
5. Dispositif à fluide et élastomère selon la revendication 1, également caractérisé par le fait que ledit passage primaire a un diamètre D dans la plage de 0,125 cm et 1,25 cm (0,05 et 0,5 pouce).
6. Dispositif à fluide et élastomère selon la revendication 1, également caractérisé par le fait que ledit élément en élastomère comprend un élastomère ayant un coefficient de perte inférieur à 0,4.
7. Dispositif à fluide et élastomère selon la revendication 1, également caractérisé par des moyens (50) destinés à mettre ledit fluide sous pression.
8. Dispositif à fluide et élastomère selon la revendication 1, également caractérisé par le fait que ledit fluide a une viscosité cinématique μ et que ledit diamètre D, ladite longueur L et ladite viscosité cinématique μ sont choisis pour donner une rigidité K^* , K' , et K'' linéaire en fonction de l'amplitude.
9. Dispositif à fluide et élastomère selon la revendication 1, également caractérisé par un organe flottant à l'intérieur dudit ensemble formant passage, qui est chargé élastiquement par un ressort hélicoïdal ayant une rigidité de 1 339 kg/m (75 livres/pouce).
10. Dispositif à fluide et élastomère selon la revendication 1, également caractérisé par le fait que ledit passage auxiliaire comprend plusieurs canaux.
11. Dispositif à fluide et élastomère selon la revendication 1, également caractérisé par le fait qu'il comprend, formés en lui, deux ensembles formant passages dont chacun agit dans une direction différente de telle façon que l'un limite la pression différentielle entre lesdites première et seconde chambres à volume variable dans une direction, tandis que l'autre limite la pression différentielle entre lesdites première et seconde chambres à volume variable dans l'autre direction.
12. Dispositif à fluide et élastomère selon la revendication 1, également caractérisé par le fait que ledit ensemble formant passage comprend un organe flottant comportant un siège pour empêcher de manière étanche le fluide de circuler à travers ledit chemin d'écoulement auxiliaire.
13. Dispositif à fluide et élastomère selon la revendication

tion 12, également caractérisé par des moyens destinés à ajuster l'importance de la pression exercée sur ledit siège.

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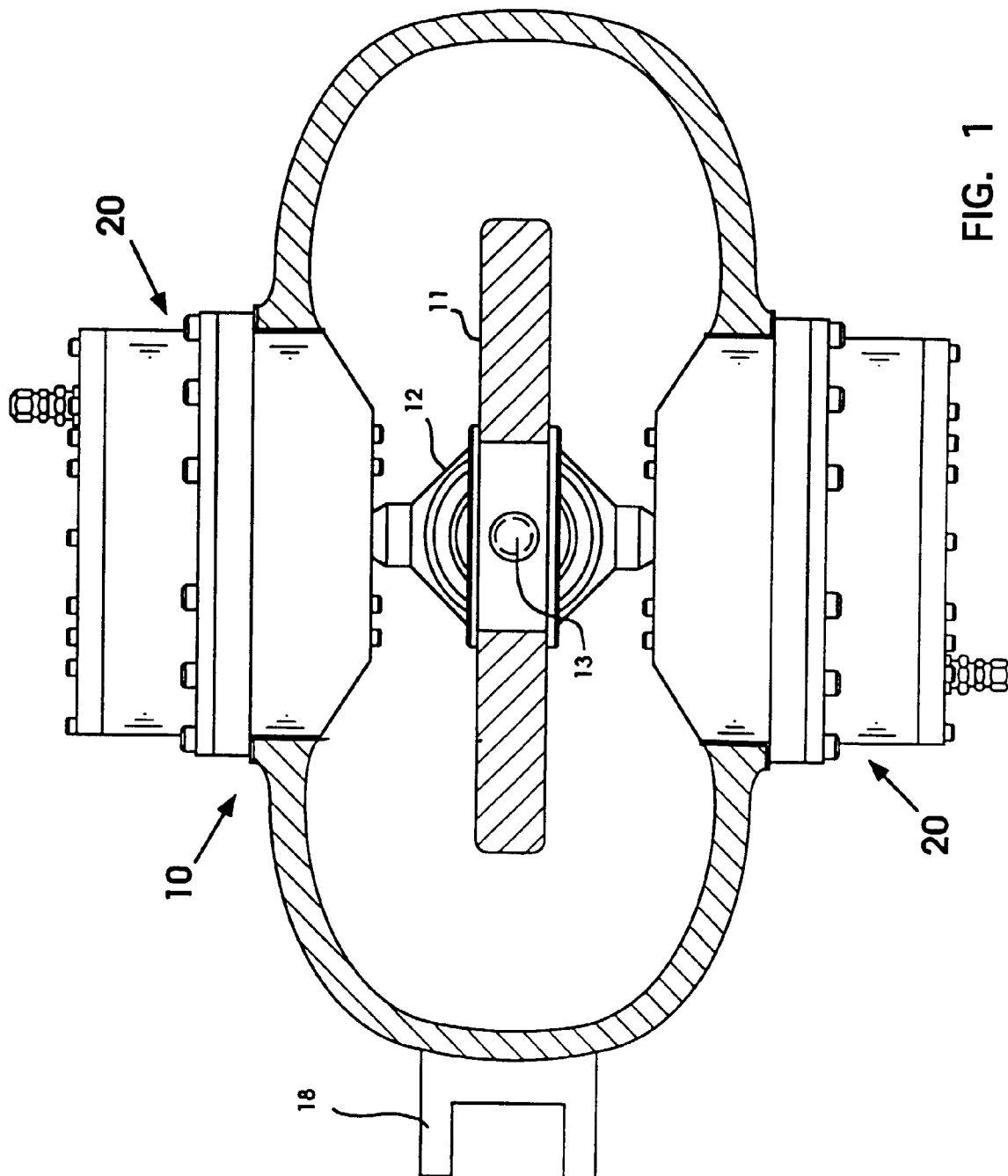
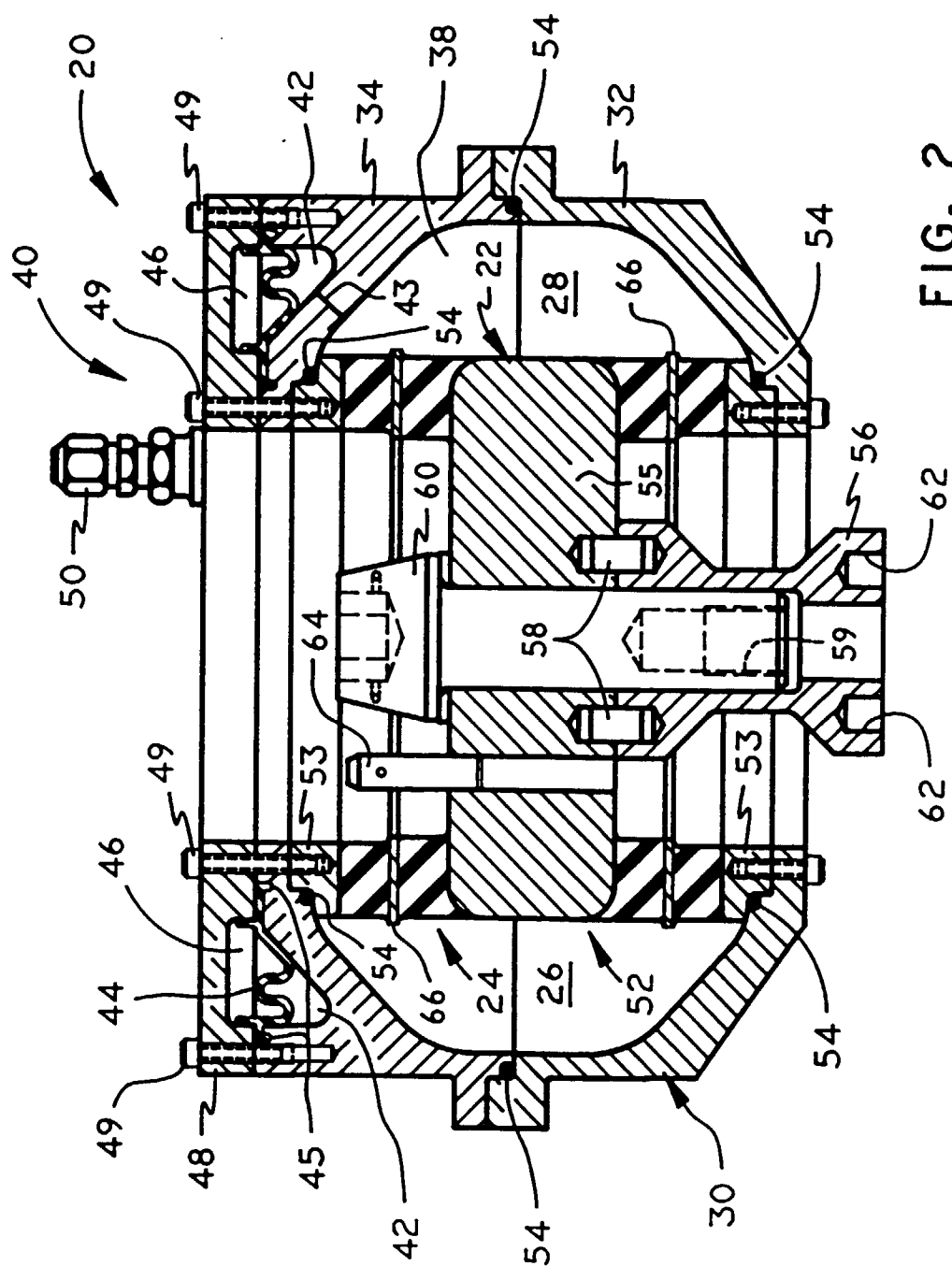
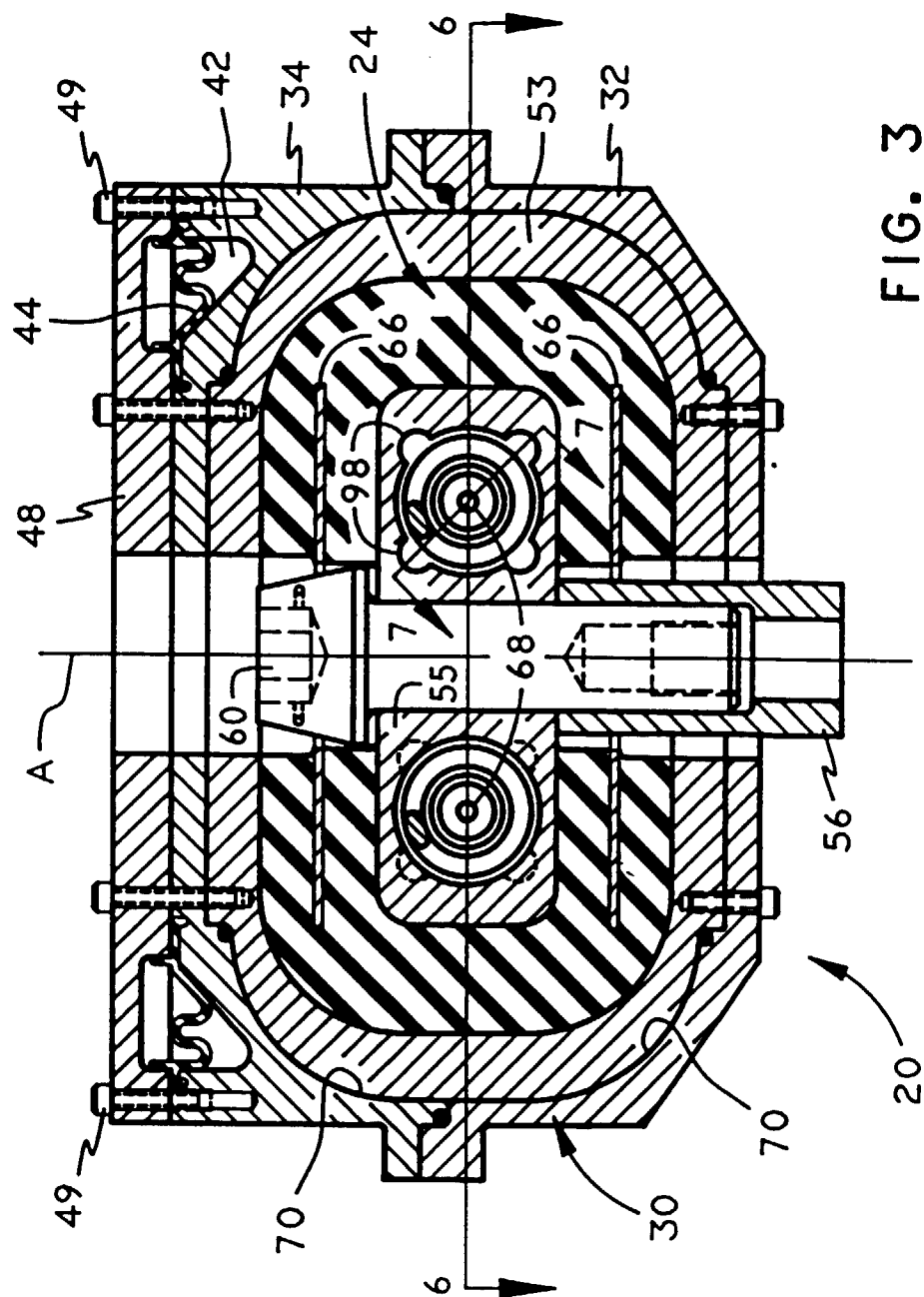


FIG. 1





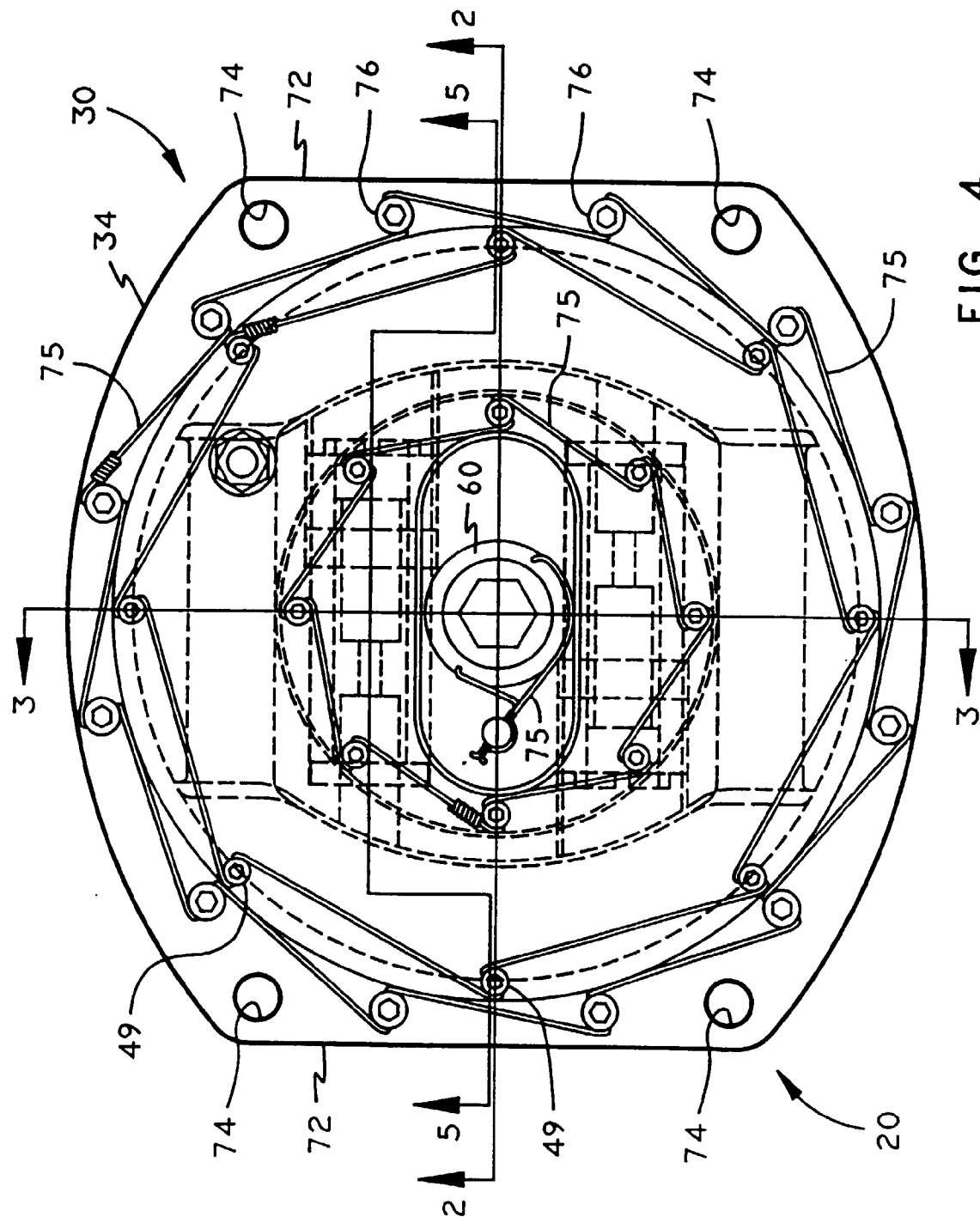


FIG. 4

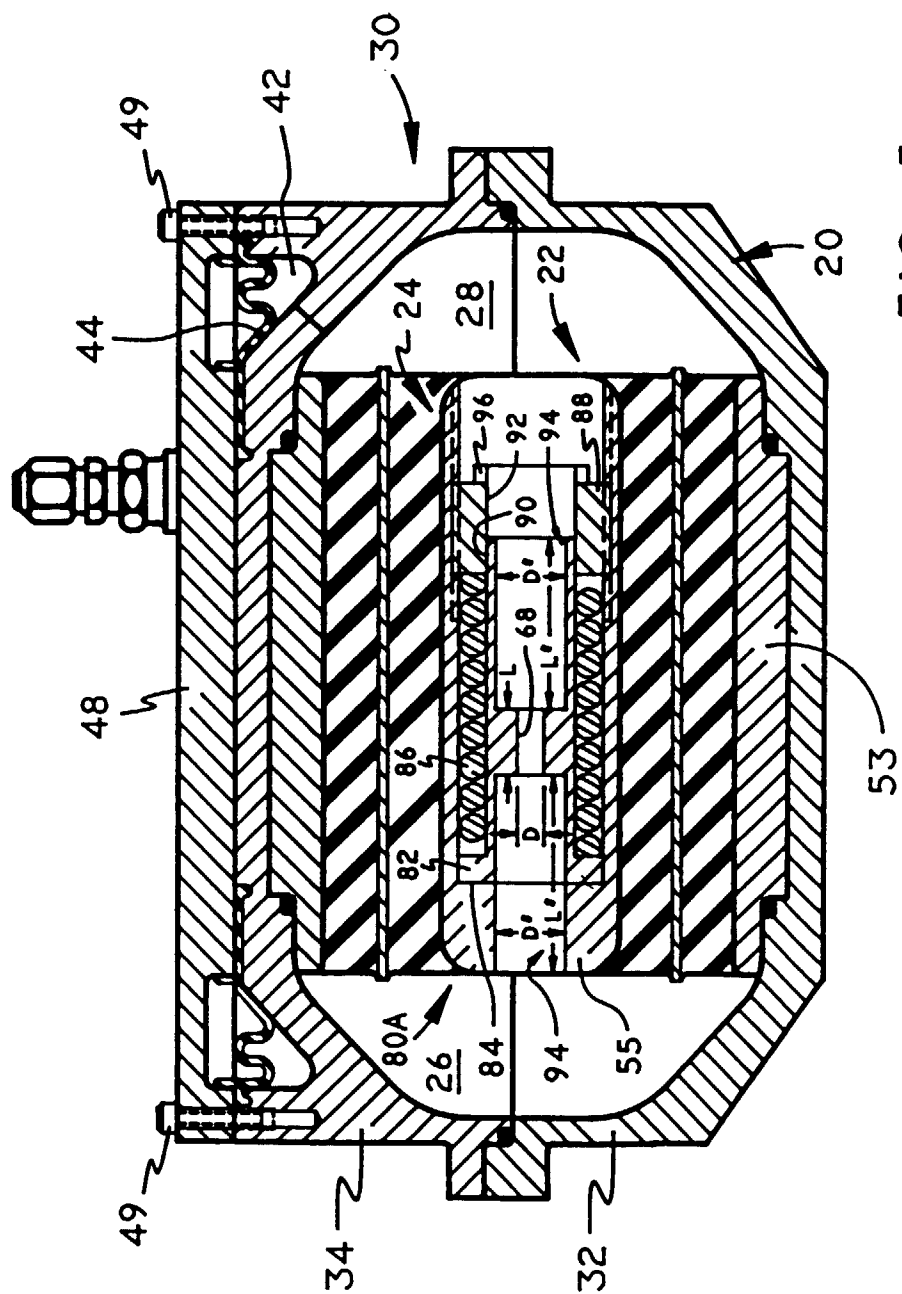


FIG. 5

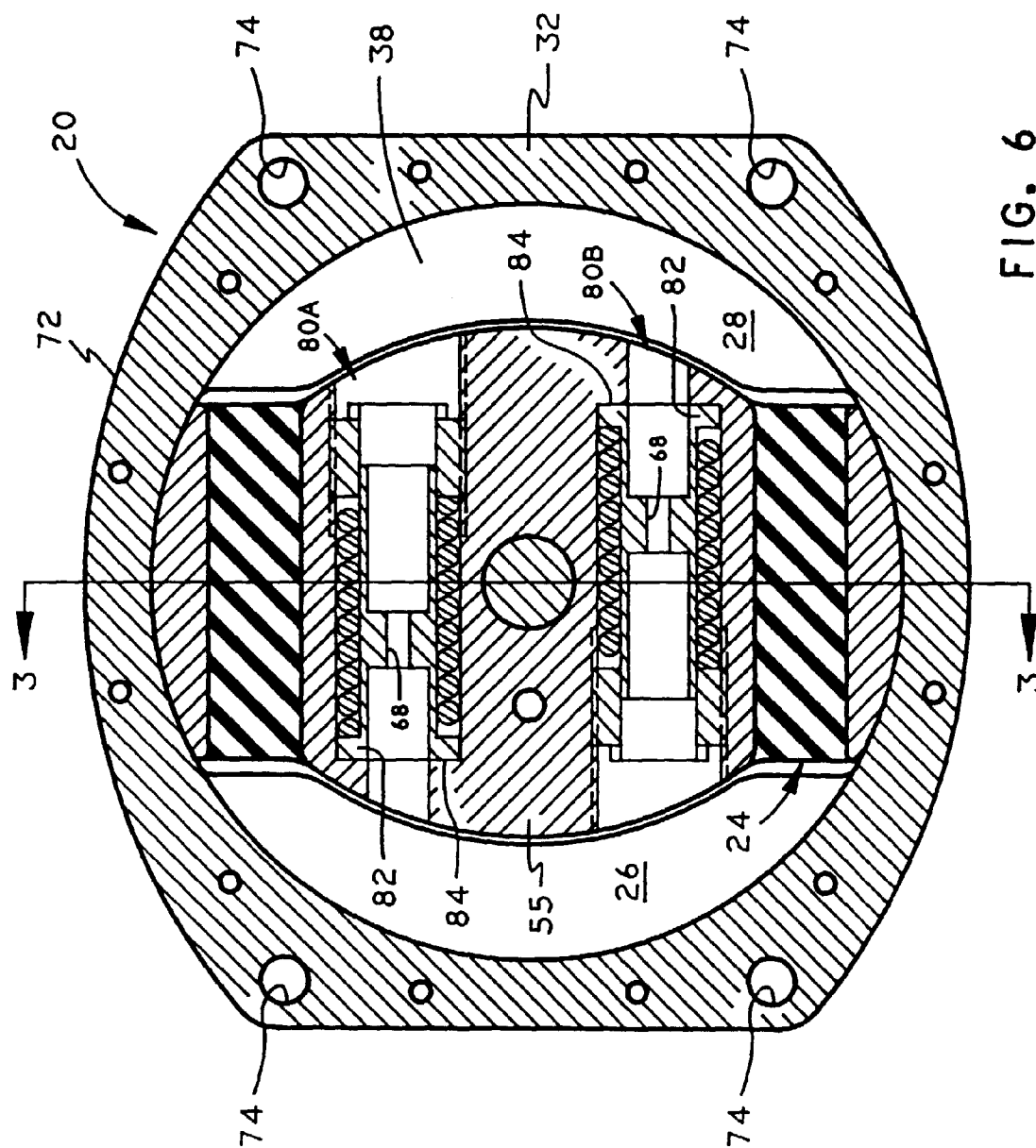


FIG. 6

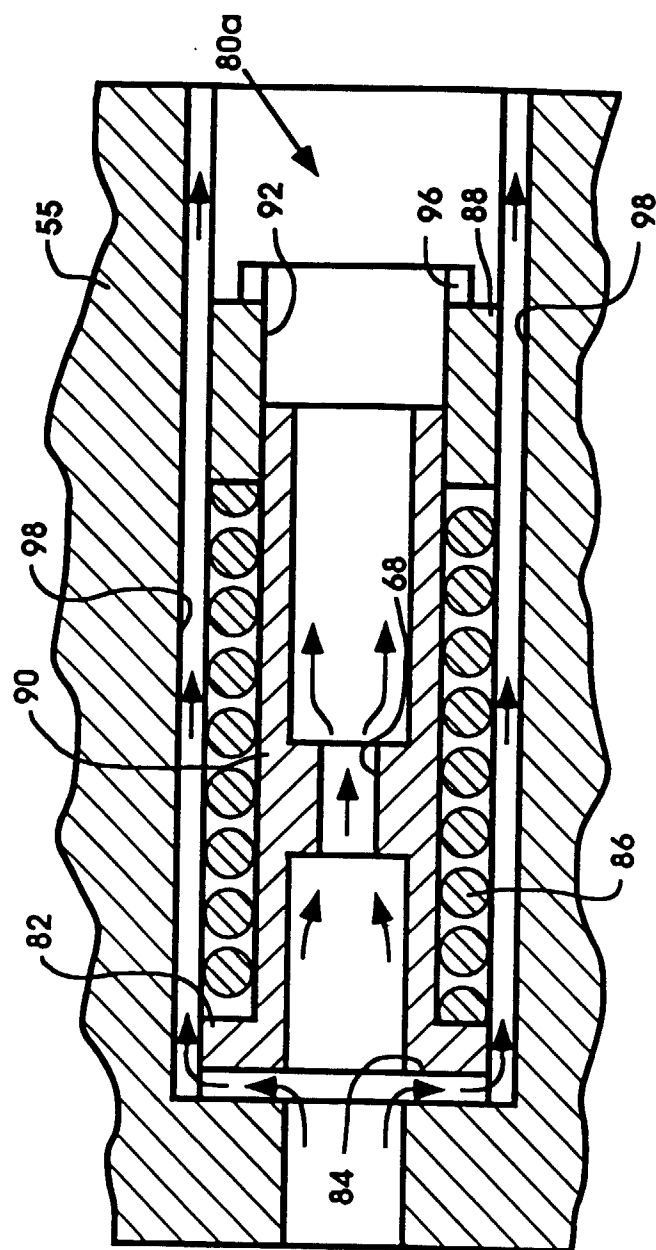


FIG. 7

